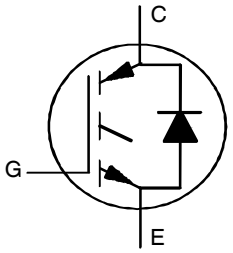
International
IOR Rectifier

AUTOMOTIVE GRADE

PD - 97637

AUIRGR4045D
AUIRGU4045D

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE



n-channel

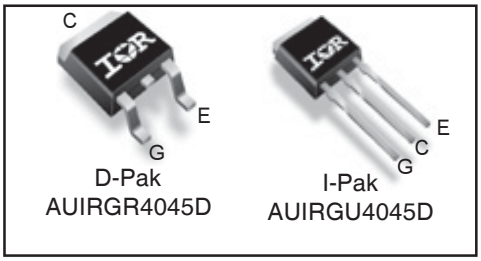
V_{CES} = 600V

I_C = 6.0A, T_C = 100°C

$V_{CE(on)\ typ.}$ = 1.7V

Features

- Low $V_{CE\ (on)}$ Trench IGBT Technology
- Low Switching Losses
- Maximum Junction temperature 175 °C
- 5µs SCSOA
- Square RBSOA
- 100% of the parts tested for I_{LM}①
- Positive $V_{CE\ (on)}$ Temperature Coefficient.
- Ultra Fast Soft Recovery Co-pak Diode
- Tighter Distribution of Parameters
- Lead-Free, RoHS Compliant
- Automotive Qualified*



Benefits

- High Efficiency in a Wide Range of Applications
- Suitable for a Wide Range of Switching Frequencies due to Low $V_{CE\ (ON)}$ and Low Switching Losses
- Rugged Transient Performance for Increased Reliability
- Excellent Current Sharing in Parallel Operation
- Low EMI

G	C	E
Gate	Colletor	Emitter

Absolute Maximum Ratings

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature (T_A) is 25°C, unless otherwise specified.

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V
I_C@ T_C = 25°C	Continuous Collector Current	12	A
I_C@ T_C = 100°C	Continuous Collector Current	6.0	
I_{CM}	Pulsed Collector Current, V_{GE} = 15V	18	
I_{LM}	Clamped Inductive Load Current, V_{GE} = 20V ①	24	
I_F@T_C=25°C	Diode Continuous Forward Current	8.0	
I_F@T_C=100°C	Diode Continuous Forward Current	4.0	
I_{FM}	Diode Maximum Forward Current ②	24	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20	V
	Transient Gate-to-Emitter Voltage	± 30	
P_D @ T_C =25°	Maximum Power Dissipation	77	W
P_D @ T_C =100°	Maximum Power Dissipation	39	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds	300 (0.063 in. (1.6mm) from case)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT ③	—	—	1.9	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode ③	—	—	6.8	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) ⑤	—	—	50	
$R_{\theta JA}$	Junction-to-Ambient	—	—	110	

*Qualification standards can be found at http://www.irf.com/

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V_{GE} = 0V, I_c =100 µA ④	CT6
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.36	—	V/°C	V_{GE} = 0V, I_c = 250µA (25 -175 °C) ④	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.7	2.0	V	I_C = 6.0A, V_{GE} = 15V, T_J = 25°C	5,6,7,9, 10 ,11
		—	2.07	—		I_C = 6.0A, V_{GE} = 15V, T_J = 150°C	
		—	2.14	—		I_C = 6.0A, V_{GE} = 15V, T_J = 175°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.5	—	6.5	V	V_{CE} = V_{GE}, I_C = 150µA	9,10,11,12
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-13	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA (25 -175 °C)	
gfe	Forward Transconductance	—	5.8	—	S	V_{CE} = 25V, I_C = 6.0A, PW =80µs	
I_{CES}	Collector-to-Emitter Leakage Current	—	—	25	µA	V_{GE} = 0V,V_{CE} = 600V	8
		—	—	250		V_{GE} = 0V, V_{CE} = 600V, T_J =175°C	
V_{FM}	Diode Forward Voltage Drop	—	1.60	2.30	V	I_F = 6.0A	
		—	1.30	—		I_F = 6.0A, T_J = 175°C	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ± 20 V	

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
Q_g	Total Gate Charge (turn-on)	—	13	19.5	nC	I_C = 6.0A	24
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	3.1	4.65		V_{CC} = 400V	CT1
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	6.4	9.6		V_{GE} = 15V	
E_{on}	Turn-On Switching Loss	—	56	86	µJ	I_C = 6.0A, V_{CC} = 400V, V_{GE} = 15V	CT4
E_{off}	Turn-Off Switching Loss	—	122	143		R_G = 47Ω, L=1mH, L_S= 150nH, T_J = 25°C	
E_{total}	Total Switching Loss	—	178	229		Energy losses include tail and diode reverse recovery	
$t_{d(on)}$	Turn-On delay time	—	27	35	ns	I_C = 6.0A, V_{CC} = 400V	CT4
t_r	Rise time	—	11	15		R_G = 47Ω, L=1mH, L_S= 150nH	
$t_{d(off)}$	Turn-Off delay time	—	75	93		T_J = 25°C	
t_f	Fall time	—	17	22			
E_{on}	Turn-On Switching Loss	—	140	—	µJ	I_C = 6.0A, V_{CC} = 400V, V_{GE} = 15V	13,15
E_{off}	Turn-Off Switching Loss	—	189	—		R_G = 47Ω, L=1mH, L_S= 150nH, T_J = 175°C	CT4
E_{total}	Total Switching Loss	—	329	—		Energy losses include tail and diode reverse recovery	WF1,WF2
$t_{d(on)}$	Turn-On delay time	—	26	—	ns	I_C = 6.0A, V_{CC} = 400V	14,16
t_r	Rise time	—	12	—		R_G = 47Ω, L=1mH, L_S= 150nH	CT4
$t_{d(off)}$	Turn-Off delay time	—	95	—		T_J = 175°C	WF1,WF2
t_f	Fall time	—	32	—			
C_{ies}	Input Capacitance	—	350	—	pF	V_{GE} = 0V	23
C_{oes}	Output Capacitance	—	29	—		V_{CC} = 30V	
C_{res}	Reverse Transfer Capacitance	—	10	—		f = 1Mhz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 175°C, I_C = 24A V_{CC} = 500V, Vp =600V R_G = 100Ω, V_{GE} = +20V to 0V	4 CT2
SCSOA	Short Circuit Safe Operating Area	—	5	—	µs	V_{CC} = 400V, Vp =600V R_G = 100Ω, V_{GE} = +15V to 0V	22 CT3, WF4
Erec	Reverse recovery energy of the diode	—	178	—	µJ	T_J = 175°C	17,18,19
trr	Diode Reverse recovery time	—	74	—	ns	V_{CC} = 400V, I_F = 6.0A	20,21
Irr	Peak Reverse Recovery Current	—	12	—	A	V_{GE} = 15V, Rg = 47Ω, L=1mH, L_S=150nH	WF3

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 15V, L = 1.0mH, R_G = 47Ω.
② Pulse width limited by max. junction temperature.
③ R_θ is measured at T_J approximately 90°C.
④ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
⑤ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.